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ENTOM.

INEFFECTIVENESS OF INTERNAL MEDICATION OF POULTRY FOR THE CONTROL OF EXTERNAL PARASITES

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PART 1. TESTS OF MATERIALS ADMINISTERED INTERNALLY TO FOWLS TO DETERMINE THEIR EFFECT ON EXTERNAL PARASITES

INTRODUCTION

There is a general impression among farmers, poultrymen, and stockmen that certain chemicals, administered internally, will protect animals from external parasites. The prevailing idea is that the material is taken up by the blood and excreted on the surface of the body or on the body coverings. It is commonly believed that when parasites come in contact with such portions they are poisoned or repelled by the chemical.

As this impression has been commercialized to the extent of several million dollars during the last few years, and as several of the proprietary remedies have been tested for fowls and found ineffective, it was deemed advisable to make controlled tests of some of the chemicals most generally used. The purpose was to determine whether any control of external parasites of poultry is derived from internal administrations of chemicals used for that purpose. Records were made to show the effects of such medication on hens and on the parasites infesting them.[3]

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[1] Resigned Jan. 25, 1928.

[2] Part 1 was written by D. C. Parman; part 2, by W. S. Abbott, J. J. Culver, and W. M. Davidson.

PROCEDURE

FOWLS USED

The fowls used were hens procured from ranches and poultry yards in the vicinity of Uvalde, Tex. All were Leghorns except 35 included in the tests shown in Table 5, which were of mixed breeds. Most of them were healthy yearlings, but a few were mature pullets. They were confined in pens from one to two weeks previous to the tests in order to cull out any that might show weaknesses or diseases, and also to accustom the others to their new environment. New fowls were procured for each test, except that the hens used as controls were sometimes used in the following series of tests by distributing them so that they received medication with other hens.

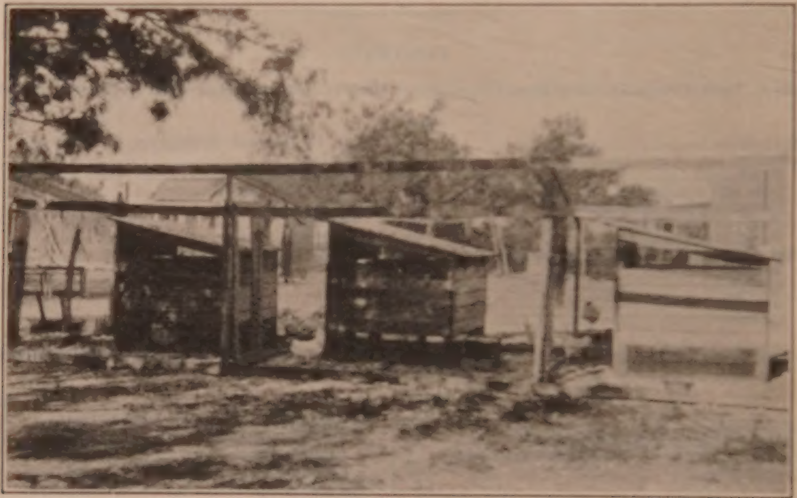

FIG. 1.—Three of the series of pens in which the tests of internal remedies were carried out

PENS AND EQUIPMENT

The pens (fig. 1) were approximately 9 feet square, and located on ground covered with medium-size gravel. In each pen there was a shelter about 4 feet square and 5 feet high, covered with a shed roof. Three sides were boarded up except for about 10 inches at the bottom. The roosts were made of two 1 by 2 inch strips of board loosely bolted together, and supported by stakes driven into the ground. The stakes were insulated from the floor by a band of tar. The roosts were short enough to prevent the fowls from coming in contact with the walls of the shelter.

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[3] These studies were conducted under the direction of F. C. Bishopp, Senior Entomologist, in charge of Division of Insects Affecting Man and Animals.

CHEMICALS AND TREATMENTS

Most of the materials used were analyzed and furnished by the Insecticide and Fungicide Board[4] of the United States Department of Agriculture, and were designated in their report as pure, good grade, and C. P. The following materials were used: Magnesium sulphate (Epsom salt), $MgSO_4.7H_2O$; sodium carbonate, Na_2CO_3, C. P.; naphthalene, good technical grade; calcium thiosulphate, contained 31.7 per cent of calcium thiosulphate, $CaS_2O_3.6H_2O$, and 46.9 per cent of calcium sulphite, $CaSO_3.2H_2O$; calcium sulphate, $CaSO_4.2H_2O$, good grade; calcium sulphide, contained 52 per cent CaS, 5.5 per cent C, 20.5 per cent $CaCO_3$, 6 per cent $CaSO_4$, 16 per cent water and undetermined; magnesium oxide, MgO, 95 per cent, $MgCO_3$, 4.4 per cent; sodium sulphate, $Na_2SO_4.10H_2O$, good grade; potassium nitrate, KNO_3, C. P.; ferric oxide, Fe_2O_3, C. P.; ferric sulphate, $Fe_2(SO_4)_3$; ferrous sulphate, $Fe_2SO_4.7H_2O$, C. P.; potassium tellurate, K_2TeO_4, C. P.; potassium tellurite, K_2TeO_3, C. P.; diethyl diselenide $(C_2H_5)_2Se_2$, C. P.; sodium nitrate $NaNO_3$, C. P.; tartar emetic, $KSbOC_4H_4O_6.\frac{1}{2}H_2O$, C. P.; potassium iodide, KI, C. P.; sulphur, flowers; potassium bitartrate, $KHC_4H_4O_6$; potassium carbonate, K_2CO_3; capsicum, pure, powdered; gentian, pure, powdered; ginger, Jamaica, pure, powdered; fenugreek, pure, powdered; garlic, dried; gum camphor, refined; tobacco, powdered, 1.08 per cent nicotine, 88 per cent passing through a 100-mesh sieve; quinine sulphate, U. S. P.; nux vomica, U. S. P.

The doses were weighed and administered in No. 00 gelatine capsules. Garlic buttons were weighed and administered without capsules or other protection. In the pen tests calcium thiosulphate, calcium polysulphide-A, calcium polysulphide-B, and sodium sulphate were dissolved in water in such proportions that a capsule would hold the desired dose. Diethyl diselenide was dissolved in alcohol and put up in like manner. All materials were administered in the afternoon just before the grain feed was given.

The individual dosage was not in porportion to the weight of the hens in the tests, as the quantity which would be a safe dosage had not been accurately determined. Administering doses of equal weights to hens of different weights aided in establishing the dosage according to the weight of the hens.

The experiments were divided into two séries of dosage tests and five series of pen tests. In the first series of dosage tests (Table 1) each pen contained seven hens, three for each material to be tested, and one hen to serve as a control. Each hen in this series received a different dosage. In the second period this dosage was greatly increased, in most cases to about eight times the quantity originally used. The tests in the second series (Table 2) were carried out like the first except that each hen received the same dosage each day.

In the pen tests (Tables 3, 4, and 5) there were five hens in each pen, all of which received the same medication and dosage. A pen of five hens was run with each series as a control. The size of the dose was selected for these pen tests on the basis of the results secured in the dosage tests, an attempt being made to select a dose for a hen that would be practically the limit of her tolerance for that material.

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[4] On July 1, 1927, the Insecticide and Fungicide Board ceased to exist, and its functions were transferred to the Food, Drug, and Insecticide Administration.

TABLE 1.—*Results of dosage tests to determine the effect on ectoparasites of the internal administration of certain materials to individual fowls, Uvalde, Tex., 1924*

[Explanation of symbols used in this and subsequent tables: Health symbols—"OK", not affected; "F" (fair), appreciably affected; "P" (poor), unable to walk. Appetite symbols—"OK," eager for grain; "F," ate moderately; "P," ate very little. Bowel symbols—"N" (normal), feces firm and normal; "SL" (slightly loose), droppings soft; "L" (loose), feces without form, very soft. Infestation symbols—"O," no infestation; "VF," very few; "F," few; "L," light; "M," medium; "H," heavy; and "VH," very heavy.]

Pen No.	Material administered	Dosage[1] per hen		Hen No.	Weight at beginning of test		Loss (−) or gain (+) at end of test	Condition of hen during test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Fowl tick larvae on hen	
		Feb. 6 to Mar. 20	Mar. 24 to Apr. 9					Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage attached
		Grams	*Grams*		*Lbs.*	*Oz.*	*Ounces*											
5	Potassium nitrate	0.005	0.04	1	5	4	−9	OK	OK	L	F	VH	F	F	F	H	125	13.6
	do	.01	.08	2	4	6	−8	OK	OK	N	H	VH	F	M	VF	F	125	11.2
	do	.02	.16	3	4	11	−8	OK	OK	N	VF	M	F	F	M	M	225	31.5
	Magnesium oxide	.05	.4	4	3	6	−2	OK	OK	SL	VF	F	F	M	F	M	125	16.8
	do	.09	.8	5	3	8	[2] 0	OK	OK	SL	VF	H	VF	F	M	M	125	15.2
	do	.18	1.6	6	3	4	[3] −1	OK	OK	SL	VF	VF	F	F	M	M	225	34.2
	None (control)			31	5	3	−6	OK	OK	L	VH	M	VF	L	O	F	225	31.6
1	Magnesium sulphate	.4	2.0	7	3	8	−5	OK	OK	L	O	F	VF	M	H	L	125	12.8
	do	.8	4.0	8	4	1	−5	OK	OK	N	F	F	M	M	M	F	125	15.2
	do	1.25	6.0	9	4	2	−7	OK	OK	L	VH	L	M	H	F	M	225	28.9
	Calcium sulphate	.004	.03	10	4	5	−11	OK	OK	SL	H	M	F	L	M	M	125	14.4
	do	.008	.06	11	7	12	−4	OK	OK	L	VH	VH	F	M	F	M	125	12.0
	do	.016	.12	12	3	0	−2	OK	OK	SL	M	L	VF	F	F	F	225	31.6
	None (control)			32	3	12	−6	OK	OK	N	O	F	VF	M	M	F	225	29.9
2	Calcium sulphide	.004	.03	13	4	1	−2	OK	OK	N	VF	VF	F	M	F	F	125	11.5
	do	.008	.06	14	3	13	−3	OK	OK	L	F	F	F	M	F	M	125	12.0
	do	.016	.12	15	4	2	−4	OK	OK	L	O	F	F	L	M	F	225	28.5
	Sodium sulphate	.015	.12	16	3	4	−2	OK	OK	L	O	F	F	F	M	M	125	12.8
	do	.03	.24	17	3	2	−1	OK	OK	SL	F	H	F	M	F	M	125	12.0
	do	.06	.48	18	4	13	−12	OK	OK	N	VF	VH	VF	L	F	F	225	28.0
	None (control)			33	3	8	+4	OK	OK	SL	F	VF	VF	M	F	M	255	28.5
3	Sodium carbonate	.025	.2	19	4	0	−3	OK	OK	SL	F	VH	F	M	F	F	125	12.8
	do	.05	.4	20	4	1	−5	OK	OK	L	O	L	F	M	F	M	125	12.0
	do	.1	.8	21	4	4	−5	OK	OK	L	VF	F	F	F	F	F	225	30.7
	Ferrous sulphate	.004	.03	22	4	11	−1	OK	OK	SL	VH	H	F	L	F	M	125	9.4
	do	.008	.06	23	4	4	−11	OK	OK	L	VH	H	F	M	O	L	125	12.0
	do	.016	.12	24	4	0	+6	OK	OK	N	O	L	VF	H	F	L	225	28.5
	None (control)			34	3	15	−12	OK	OK	N	M	F	O	M	M	F	225	33.8
4	Ferric sulphate	.004	.03	25	5	13	−5	OK	OK	SL	VH	VH	F	F	F	H	125	12.0
	do	.008	.06	26	5	11	−5	OK	OK	SL	F	H	F	M	M	F	125	12.8
	do	.016	.12	27	5	14	−9	OK	OK	N	VH	VH	F	M	F	F	225	19.1
	Ferric oxide	.2	2.0	28	5	4	−2	OK	OK	N	H	M	F	M	M	VH	125	11.2
	do	.4	4.0	29	3	7	−2	OK	OK	SL	O	F	VF	L	F	F	125	14.4
	do	.8	7.0	30	4	6	−13	OK	OK	SL	H	VH	VF	M	F	F	225	42.4
	None (control)			35	3	8	+4	OK	OK	N	H	H	VF	M	F	F	225	28.9

[1] Doses were administered daily except Sundays and were given in capsules.

[2] Lost 3 ounces but recovered.

[3] Lost 6 ounces but regained 5.

TABLE 2.—*Results of dosage tests to determine the effect on ectoparasites of the internal administration of certain materials to individual hens, April 15 to May 16, 1924, Uvalde, Tex.*

[For explanation of symbols see note at top of Table 1]

Pen No.	Material administered	Dosage[1] per hen	Hen No.	Weight at beginning of test		Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Fowl tick larvae on hen	
							Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage engorged
		Grams		*Lbs.*	*Oz.*	*Ounces*											
5	Calcium thiosulphate	0.03	36	5	6	+2	F	OK	N	VF	F	F	L	F	M	100	16.0
	do	.06	37	3	14	+1	OK	OK	N	F	O	F	H	VH	H	100	27.0
	do	.12	38	3	6	0	F	OK	N	O	O	VF	M	VF	L	200	12.0
	Potassium tellurate	.01	40	4	6	−7	OK	OK	SL	VH	H	M	M	R	F	100	32.0
	do	.02	41	3	5	−5	F	OK	N	M	VF	L	M	L	L	100	12.0
	do	.04	42	3	14	+1	P	OK	N	M	M	H	H	F	M	200	19.0
	None (control)		39	4	15	+5	OK	OK	N	H	H	M	M	F	H	200	11.0
1	Napthalene	.02	43	4	8	+4	F	OK	L	H	H	L	L	F	H	100	21.0
	do	.04	44	2	12	+2	F	OK	L	L	F	M	H	F	M	100	18.0
	do	.08	45	4	6	−2	F	OK	L	L	O	L	M	L	F	200	25.0
	Gentian	.16	47	2	9	0	F	OK	L	O	O	F	M	F	M	100	10.0
	do	.4	48	3	5	+2	F	OK	L	F	VF	F	M	F	H	100	14.0
	do	.8	49	3	10	+4	F	OK	N	F	F	L	L	F	F	200	26.0
	None (control)		46	4	6	0	OK	OK	N	H	L	VF	M	M	M	200	11.0
2	Camphor gum	.3	50	3	5	−1	OK	OK	N	F	F	F	F	F	F	100	25.0
	do	.5	51	3	8	+1	F	OK	N	F	L	L	M	M	F	100	11.0
	do	.85	[2] 52	4	5	−21	VP	P	N	O	VF	F	M	F	L	200	30.0
	Capsicum	.05	54	4	0	+8	OK	OK	N	F	L	F	M	F	F	100	27.0
	do	.1	55	3	8	+4	F	OK	N	O	O	F	L	F	M	100	11.0
	do	.2	[3] 56	3	13	−3	P	F	L	M	M	M	M	F	F	200	19.5
	None (control)		53	3	0	+1	F	OK	N	O	O	F	M	L	L	200	21.0
3	Fenugreek	.2	57	2	10	+7	OK	OK	L	F	O	M	M	F	F	100	28.0
	do	.4	58	3	6	+2	F	OK	L	O	O	F	L	VF	L	100	11.0
	do	.8	59	3	12	+3	OK	OK	N	L	VF	F	L	F	F	200	11.5
	Ginger	.12	61	4	9	−7	OK	OK	N	H	H	F	M	F	M	100	7.0
	do	.24	62	3	5	0	F	OK	N	O	F	L	F	F	F	100	27.0
	do	.8	63	3	6	−1	F	OK	N	O	O	F	L	L	F	200	18.0
	None (control)		60	4	2	+3	OK	OK	SL	H	VH	VF	F	H	M	200	15.5
4	Sulphur flowers	1.0	64	2	12	+3	OK	OK	L	VH	VH	L	L	F	F	100	11.0
	do	2.0	65	4	0	+1	OK	OK	L	VF	O	F	L	VF	F	100	15.0
	do	4.0	[4] 66	3	12	−5	F	OK	SL	H	M	F	M	F	F	200	14.0
	Garlic	1.0	67	3	5	−1	OK	OK	N	H	L	L	H	VF	F	100	35.0
	do	2.0	68	4	3	+8	OK	OK	N	VH	VH	L	L	F	H	100	37.0
	do	4.0	69	3	8	+5	OK	OK	L	VF	O	F	L	F	L	200	10.5
	None (control)		70	2	13	0	OK	OK	L	L	L	F	L	F	L	200	13.0

[1] All doses were administered daily except Sundays, and with the exception of garlic they were given in capsules.

[2] No. 52 became sick and was unable to walk May 5, and died May 29. In the case of this hen and others referred to in the footnotes of the tables as being sick, medication was discontinued on the day the hen was unable to stand.

[3] No. 56 died May 15 after a few days droopiness and inability to stand May 14. Data in following columns are those recorded Apr. 28.

[4] No. 66 was unable to stand May 9, but recovered a few weeks later.

TABLE 3.—*Results of pen tests to determine the effect on ectoparasites of the internal administration of certain materials to fowls, July 15 to August 4, 1924, Uvalde, Tex.*

[For explanation of symbols see note at top of Table 1]

Pen No.	Material administered	Dosage[1] per hen	Hen No.	Weight at beginning of test		Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Flea infestation on hen		Fowl tick larvae and nymphs on roosts[2]	
							Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage engorged
		Grams		*Lbs.*	*Oz.*	*Ounces*													
1	Magnesium sulphate	6.0	71	4	3	−7	OK	OK	SL	O	O	M	L	F	F	2	21	320	32.5
	do	6.0	72	4	0	−2	OK	OK	L	F	F	M	M	H	H	1	54		
	do	6.0	73	2	9	−1	OK	OK	SL	O	F	M	H	F	F	10	75		
	do	6.0	74	3	0	−2	OK	OK	L	O	F	H	H	F	F	7	100		
	do	6.0	75	2	13	−1	OK	OK	L	F	F	M	F	F	F	5	47		
[3] 2	Magnesium oxide	1.6	76	3	3				N	O		F		M		15		320	41.2
	do	1.6	77	4	0	−8	F	P	N	F	F	F	M	F	M	2	200		
	do	1.6	78	3	1			P	N	O		F		F		3			
	do	1.6	79	3	7	−11	P	P	N	F	F	F	M	F	F	9	47		
	do	1.6	80	4	3	−7	P	P	N	F	F	F	M	F	F	5	41		
3	Ferric oxide	6.0	81	3	11	−7	F	OK	N	O	O	F	F	F	M	5	15	320	16.0
	do	6.0	82	3	4	−5	OK	OK	N	O	O	F	F	F	F	4	23		
	do	6.0	83	2	9	+1	F	OK	N	O	F	M	F	F	F	7	11		
	do	6.0	84	2	15	0	F	OK	N	O	F	F	M	F	F	1	17		
	do	6.0	85	3	9	+8	OK	OK	N	O	O	M	F	F	F	8	7		
4	Garlic	6.0	86	3	10	−2	OK	OK	SL	F	F	M	M	H	F	4	5	320	17.2
	do	6.0	87	3	4	−4	OK	OK	N	O	O	M	F	F	M	0	0		
	do	6.0	88	3	6	−2	OK	OK	N	O	O	M	F	F	F	1	0		
	do	6.0	89	3	13	−3	OK	OK	N	H	VH	F	M	F	F	1	2		
	do	6.0	90	3	9	−5	OK	OK	N	O	O	F	F	F	F	1	0		
5	Sulphur flowers	2.0	91	2	15	+1	OK	OK	N	O	F	M	M	F	F	4	5	320	22.5
	do	2.0	92	3	3	−3	OK	OK	N	F	O	M	M	F	M	0	0		
	do	2.0	93	3	11	−7	OK	OK	L	M	F	H	H	F	F	6	7		
	do	2.0	94	5	2	+1	OK	OK	L	O	F	M	M	F	F	1	0		
	do	2.0	95	5	1	−2	OK	OK	N	F	M	F	M	F	H	0	0		
6	None (control)		96	4	8	−5	OK	OK	N	L	M	F	H	F	M	0	0	320	12.8
	do		97	3	1	−4	OK	OK	N	O	O	M	M	F	F	1	1		
	do		98	4	1	0	OK	OK	SL	H	H	M	M	F	F	0	4		
	do		99	3	14	−5	OK	OK	N	F	O	F	M	F	F	0	0		
	do		100	3	11	0	OK	OK	N	O	O	F	M	F	F	0	0		

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[1] All doses were administered daily except Sundays, and with the exception of garlic they were given in capsules.

[2] The figures under this heading apply to each pen and not to an individual hen.

[3] Hen No. 76 died July 28; hen No. 78 died July 30. All of the hens in this pen became weak. No. 76 was not given any capsules after July 26, No. 78 none after July 28, and the other three none after July 29.

TABLE 4.—*Results of pen tests to determine the effect on ectoparasites of the internal administration of certain materials to fowls, August 12 to September 1, 1924, Uvalde, Tex.*[1]

[For explanation of symbols see note at top of Table 1]

Pen No.	Material administered	Dosage[2] per hen	Hen No.	Weight at beginning of test		Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Flea infestation on hen		Fowl tick larvae and nymphs on roosts[3]	
							Health	Appetite	bowels	Beginning	End	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage engorged
		Grams		*Lbs.*	*Oz.*	*Ounces*													
4	Potassium nitrate	0.16	101	2	13	−6	F	OK	N	O	F	L	F	F	F	10	0	300	16.3
	do	.16	102	2	10	−1	F	OK	N	O	O	F	M	F	F	15	0		
	do	.16	103	2	13	+4	OK	OK	N	F	O	F	F	F	H	20	10		
	do	.16	104	2	12	+4	OK	OK	N	F	O	F	M	F	F	5	2		
	do	.16	105	2	12	−4	F	OK	N	O	F	L	L	F	M	0	10		
5	Calcium polysulphide-B	.12	106	3	4	−3	OK	OK	N	O	O	M	L	F	F	1	10	300	12.0
	do	.12	107	4	4	−6	OK	OK	N	F	O	M	M	F	H	0	1		
	do	.12	108	2	14	−7	OK	OK	N	O	O	M	L	F	F	25	15		
	do	.12	109	3	2	−1	OK	OK	SL	F	O	F	L	F	F	15	10		
	do	.12	110	3	10	0	OK	OK	N	F	L	F	L	F	F	10	10		
1	Calcium polysulphide-A	.12	[4] 111	2	11			P	L	H		H		F		30		300	21.0
	do	.12	112	3	0	0	OK	OK	SL	F	F	M	M	F	F	25	50		
	do	.12	113	3	2	−1	OK	OK	N	F	F	M	L	F	F	25	20		
	do	.12	114	2	7	+1	F	OK	N	O	O	F	F	F	F	50	75		
	do	.12	115	3	13	+5	OK	OK	N	M	F	L	L	F	F	0	1		
2	Calcium sulphate	.12	116	3	0	−7	F	OK	SL	O	F	L	H	F	F	10	25	300	21.7
	do	.12	117	3	14	+2	F	OK	N	O	O	M	L	F	F	15	20		
	do	.12	118	2	11	+4	OK	OK	N	F	F	M	L	F	F	50	50		
	do	.12	119	3	3	−2	F	OK	SL	O	F	L	L	F	F	15	10		
	do	.12	120	3	10	−2	OK	OK	N	F	O	M	M	F	L	0	0		
3	Calcium sulphide	.12	121	2	15	−5	F	OK	N	F	F	L	L	F	F	25	50	300	42.6
	do	.12	122	3	4	+1	F	OK	N	O	O	L	M	F	F	3	5		
	do	.12	123	3	2	−6	OK	OK	SL	L	F	F	L	F	F	5	2		
	do	.12	124	2	9	−5	F	OK	N	O	F	L	F	L	F	75	50		
	do	.12	125	2	9	−7	F	OK	N	F	O	L	L	F	F	5	0		
7	Calcium thiosulphate	.12	126	2	12	0	OK	OK	N	F	F	L	M	M	F	75	75	300	10.7
	do	.12	127	3	11	0	OK	OK	N	O	O	F	M	F	F	7	10		
	do	.12	128	2	15	+5	OK	OK	SL	F	O	L	L	F	M	25	10		
	do	.12	129	3	7	−3	OK	OK	N	F	F	M	M	F	F	10	0		
	do	.12	130	3	8	+2	OK	OK	N	O	O	F	M	F	F	40	0		

[1] During this test the weather was very hot and dry and this accounts partly for the small number of tick larvae and nymphs which engorged, and the light infestations of fleas.
[2] All doses were administered daily except Sundays and were given in capsules.
[3] The figures under this heading apply to each pen and not to an individual hen.
[4] No. 111 died Aug. 15. The fowl was weak and its bowels very loose on the morning of the 14th.

TABLE 4.—*Results of pen tests to determine the effect on ectoparasites of the internal administration of certain materials to fowls, August 12 to September 1, 1924, Uvalde, Tex.*—Continued

Pen No.	Material administered	Dosage per hen	Hen No.	Weight at beginning of test	Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Flea infestation on hen		Fowl tick larvae and nymphs on roosts	
						Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage engorged
		Grams		*Lbs. Oz.*	*Ounces*													
8	Sodium Sulphate	0.5	131	2 14	−1	OK	OK	N	O	F	M	L	F	F	37	10	300	23.3
	do	.5	132	2 9	+2	OK	OK	N	L	F	M	L	F	F	20	50		
	do	.5	133	2 12	0	OK	OK	N	L	L	M	M	M	F	50	150		
	do	.5	134	2 9	+5	OK	OK	N	F	O	L	F	F	F	25	50		
	do	.5	135	3 3	−1	OK	OK	N	O	O	M	F	F	F	25	25		
6	None (control)		136	3 5	−1	OK	OK	N	O	L	F	F	F	F	10	25	300	11.0
	do		137	2 14	+5	OK	OK	N	O	O	F	L	F	F	15	50		
	do		138	3 0	0	OK	OK	N	O	O	F	L	F	F	5	5		
	do		139	4 6	−7	OK	OK	N	M	F	M	H	F	M	10	10		
	do		140	3 14	−4	OK	OK	N	M	L	F	F	F	F	15	10		

TABLE 5.—*Results of pen tests to determine the effect on ectoparasites of the internal administration of certain materials to fowls, September 8–29, 1924, Uvalde, Tex.*

[For explanation of symbols see note at top of Table 1]

Pen No.	Material administered	Dosage[1] per hen	Hen No.	Weight at beginning of test	Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		Flea infestation on hen		Fowl tick larvae and nymphs on roosts[2]	
						Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Beginning	End	Number applied	Per centage engorged
		Grams		*Lbs. Oz.*	*Ounces*													
8	Sodium carbonate	0.8	141	2 12	−3	OK	OK	N	O	O	L	F	M	F	1	50	450	50.0
	do	.8	142	2 11	+5	OK	OK	SL	H	H	M	M	F	F	5	50		
	do	.8	143	3 1	0	OK	OK	N	O	O	F	F	F	L	25	25		
	do	.8	144	3 1	+4	OK	OK	N	O	O	L	M	F	F	1	75		
	do	.8	145	3 7	−9	OK	OK	N	O	O	L	F	F	M	0	25		

7	Ferrous sulphate	.12	146	2	7	0	OK	OK	N	O	O	F	F	O	H	1	8	450	40.0
	do	.12	147	3	7	−2	OK	OK	N	O	O	M	M	L	M	0	0		
	do	.12	148	4	0	+3	OK	OK	N	O	O	O	F	F	F	0	10		
	do	.12	149	4	1	0	F	OK	N	O	O	L	M	F	L	5	5		
	do	.12	150	3	0	+4	OK	OK	N	O	O	O	F	F	M	15	9		
5	Ferric sulphate	.12	151	4	2	−3	F	OK	N	O	M	F	M	F	F	0	0	450	34.9
	do	.12	152	3	1	+2	OK	OK	N	O	O	L	L	O	M	25	25		
	do	.12	153	3	14	+4	OK	OK	N	O	F	L	L	F	F	0	7		
	do	.12	154	5	0	+1	F	OK	N	F	F	F	F	O	F	0	3		
	do	.12	155	2	12	+6	OK	OK	L	O	O	F	M	O	F	1	4		
1	Naphthalene	.08	156	3	2	+4	F	OK	N	O	O	L	L	O	F	1	3	450	45.4
	do	.08	157	3	7	+2	F	OK	N	O	O	M	M	F	F	1	14		
	do	.08	158	3	5	−1	F	OK	SL	O	O	L	F	F	F	5	15		
	do	.08	159	2	15	−2	OK	OK	N	O	F	F	L	O	M	25	25		
	do	.08	160	2	14	−7	OK	OK	N	O	O	L	L	O	F	25	15		
2	Ginger	.5	161	5	4	+4	OK	OK	SL	F	H	L	M	M	H	0	3	450	30.9
	do	.5	162	3	0	+1	OK	OK	N	O	O	F	F	M	M	5	10		
	do	.5	163	3	2	+4	OK	OK	N	O	O	F	F	M	M	50	25		
	do	.5	164	3	2	+6	F	OK	N	O	O	F	L	M	M	15	15		
	do	.5	165	2	10	+10	OK	OK	N	O	O	F	M	O	L	25	25		
3	Gentian	.8	166	2	8	+1	OK	OK	N	O	O	L	L	F	L	5	10	450	33.1
	do	.8	167	3	14	+9	OK	OK	SL	L	H	F	F	O	F	0	0		
	do	.8	168	3	11	+9	OK	OK	N	O	O	F	L	O	F	0	15		
	do	.8	169	4	4	+6	OK	OK	N	O	O	O	L	O	F	0	1		
	do	.8	170	3	8	−6	OK	OK	N	O	F	F	F	F	F	3	11		
4	Camphor gum	.5	171	3	4	−11	OK	OK	N	O	O	F	L	M	F	1	9	450	62.9
	do	.5	172	4	2	0	OK	OK	N	F	F	F	M	O	F	2	7		
	do	.5	173	2	13	−5	OK	OK	N	O	O	F	M	O	F	1	3		
	do	.5	174	2	10	−7	OK	OK	N	O	O	F	L	O	M	100	100		
	do	.5	175	3	2	−5	OK	OK	N	O	F	F	F	F	L	25	7		
9	Capsicum	.1	176	2	8	+9	OK	OK	N	O	O	M	M	F	F	2	25	450	22.4
	do	.1	177	2	15	0	OK	OK	N	O	O	F	H	F	L	2	25		
	do	.1	178	2	8	−1	OK	OK	N	O	O	L	L	F	L	25	25		
	do	.1	179	2	8	+2	F	OK	N	O	O	L	F	O	M	1	15		
	do	.1	180	3	8	−7	F	OK	N	O	O	L	F	F	M	0	3		
10	Fenugreek	.8	181	3	12	0	OK	OK	N	O	O	M	L	O	F	2	1	450	28.0
	do	.8	182	3	7	+3	OK	OK	N	O	O	L	F	M	H	0	11		
	do	.8	183	3	1	−1	OK	OK	N	F	F	F	F	O	F	0	7		
	do	.8	184	3	8	+4	OK	OK	N	O	O	M	L	F	F	0	11		
	do	.8	185	2	15	+1	OK	OK	N	O	O	L	L	O	M	0	3		
11	Potassium tellurate	.024	186	3	12	+5	OK	OK	N	O	O	F	L	F	M	0	0	450	22.0
	do	.024	187	3	1	+3	OK	OK	N	O	O	L	L	F	M	0	0		
	do	.024	188	3	0	+5	OK	OK	N	O	O	F	F	O	M	5	1		
	do	.024	189	3	0	+8	OK	OK	L	O	O	M	M	F	H	0	0		
	do	.024	190	4	0	+7	OK	OK	N	O	O	M	F	O	M	0	0		
6	None (control)		191	3	4	+1	OK	OK	N	O	O	L	L	O	L	15	15	450	16.0
	do		192	2	11	+5	OK	OK	N	O	O	L	L	M	M	25	75		
	do		193	2	14	+3	OK	OK	N	O	O	O	F	O	M	2	7		
	do		194	3	0	+2	OK	OK	N	O	O	F	F	L	F	1	4		
	do		195	4	0	+5	OK	OK	N	O	O	M	H	M	M	0	1		

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[1] All doses were administered daily except Sundays and were given in capsules.

[2] The figures under this heading apply to each pen and not to an individual hen.

FEEDS AND FEEDING

In all of the tests the same kind of commercial mash was kept before the hens at all times. This was placed in 1-gallon crocks which were cleaned each morning. In addition to this a measured quantity of dry commercial mixed grain was placed in each pen between 4 and 5 p. m. Fresh water was also provided each morning.

PARASITE INFESTATIONS

As far as possible hens were procured which were normally infested with the parasites. In the louse infestations no attempt was made to influence the abundance of the insects, the natural infestation being used in all cases. The three species of lice which were present in greatest numbers and which were recorded in these tests were the body louse (*Menopon biseriatum* Piaget), the shaft louse (*M. pallidum* Nitzsch), and the head louse (*Lipeurus heterographus* Nitzsch).

A summary of Tables 3, 4, and 5 is given in Table 6.

TABLE 6.—*Summary of pen tests given in Tables 3, 4, and 5, showing effects of internal medication of fowls on their ectoparasites*

Pen No.[2]	Material administered	Dosage per hen	Loss (−) or gain (+)	Loss (−) or gain (+) in infestation (points) [1]			Flea infestation on hens		Fowl ticks on roosts	
				Body louse	Shaft louse	Head louse	Beginning	End	Number applied	Percentage engorged
		Grams.	*Ounces*							
1	Magnesium sulphate	6.0	−13	+2	+2	0	25	297	320	32.5
[3] 2	Magnesium oxide	1.6	−26	0	+6	+2	34	288	320	41.2
3	Ferric oxide	6.0	−3	+2	−2	+2	25	73	320	16.0
4	Garlic	6.0	−16	+1	−2	−1	7	7	320	17.2
5	Sulphur flowers	2.0	−10	+1	+2	+6	11	12	320	22.5
6	None (control)		−14	0	−7	+2	1	5	320	12.8
4	Potassium nitrate	.16	−3	0	+3	+5	50	22	300	16.3
5	Calcium polysulphide-B	.12	−17	−1	0	+3	51	46	300	12.0
[4] 1	Calcium polysulphide-A	.12	+5	−2	−1	0	150	146	300	21.0
2	Calcium sulphate	.12	−5	+1	0	+1	90	105	300	21.7
3	Calcium sulphide	.12	−22	−1	+1	−1	113	107	300	42.6
7	Calcium thiosulphate	.12	+4	−1	+5	0	157	95	300	19.7
8	Sodium sulphate	.5	+5	−1	−5	−2	157	285	300	23.3
6	None (control)		−7	−1	+3	+2	55	100	300	11.0
8	Sodium carbonate	.8	−3	0	−1	+1	32	225	450	50.0
7	Ferrous sulphate	.12	+5	00	+3	+8	21	32	450	40.0
5	Ferric sulphate	.12	+10	+4	+4	+5	28	39	430	34.9
1	Naphthalene	.08	−4	+1	0	+5	57	72	450	46.4
2	Ginger	.5	+25	+3	+4	+3	95	78	450	20.9
3	Gentian	.8	+19	+3	+3	+4	8	37	450	35.1
4	Camphor gum	.5	−28	+1	+6	+4	129	128	450	62.9
9	Capsicum	.1	+3	00	+1	+7	30	93	450	22.4
10	Fenugreek	.8	+7	0	−3	+6	2	33	450	28.0
11	Potassium tellurate	.024	+28	00	−1	+13	5	1	450	22.0
6	None (control)		+16	00	+2	+4	43	102	450	16.0

[1] The louse infestation on each hen was designated as few, light, medium, heavy, and very heavy. Where no lice were found on the hen this condition was indicated as 0. There are thus five degrees of difference between no infestation (0) and very heavy infestation (vh). The numbers in the columns above indicate the sum of these degrees or points lost or gained among the five hens in each pen. 00 means no lice on any of the hens in a pen.

[2] Each pen contained 5 hens at the beginning of the test.

[3] Two hens died in pen No. 2 (magnesium oxide), and the summary is based on 3 hens.

[4] One hen died in pen No. 1 (calcium polysulphide-A), and the summary is based on 4 hens.

No fleas were present in the pens at the beginning of or at any time during the dosage tests (Tables 1 and 2), and the infestations were not entirely satisfactory in the pen tests. In the first pen tests (Table 3) suitable infestations of the sticktight flea (*Echidnophaga gallinae* Westw.) were obtained on naturally infested hens for pens Nos. 1, 2, 3, and 5. It was necessary to take 100 fleas from outside sources and infest pens Nos. 4 and 6. Suitable natural infestations were obtained in all pens for tests shown in Table 4. In tests shown in Table 5 suitable natural infestations were obtained in all pens except Nos. 3, 10, and 11, in which infested material was introduced. In other pens where fleas were introduced, satisfactory infestations were not established. Suitable natural infestations (fig. 2) were obtained for the tests shown in Tables 7 and 8.

Hens procured from places infested by ticks (*Argas miniatus* Koch) usually had larval ticks attached. They were kept in a holding pen until all of the larvae had left them. For the tests a counted number of larvae was introduced on each hen in the tests, the results of which are shown in Tables 1 and 2, and a counted number of larvae and nymphs were introduced on the roosts of the hens included in the results shown in Tables 3, 4, 5, 7, and 8. To procure the larvae for the tests a large number of female ticks were obtained and were allowed to oviposit. The larvae which hatched during a period of 48 hours, from the eggs thus procured, were used for each introduction. The nymphs used were collected as fully engorged specimens taken from the roosts of chicken houses in the vicinity. They were then held in pill boxes until they had molted and were ready for feeding. The ticks in the case of each introduction were collected on the same date, and the different nymphal stages were distributed about equally in the pens.

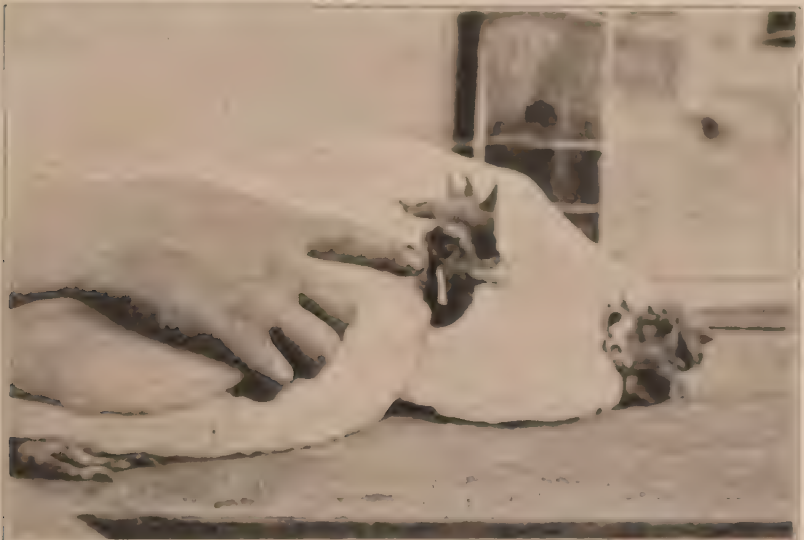

FIG. 2.—Two of the fowls at the close of one of the tests of internal remedies. The infestation of sticktight fleas about the heads was typical of many of the hens.

None of the hens in the experiments was heavily infested with scaly-leg mites (*Cnemidocoptes mutans* Robin), but active infestations were present on several of the fowls.

The infestations of the red mite (*Dermanyssus gallinae* DeGeer) were insufficient in the tests summarized in Tables 1, 2, 3, 4, and 5. In tests shown in Table 7, 500 mites were introduced on the roosts of each pen near the end of the period. In tests shown in Table 8, 100 mites were introduced on the roosts of each pen at the end of the first week of treatment and allowed to breed until the end of the tests.

Tables 7 and 8 show the results of the tests, and Table 9 gives a summary of Tables 7 and 8.

TABLE 7.—*Results of pen tests to determine the effect on ectoparasites of the internal administration of certain materials to hens, February 16 to March 28, 1925, Uvalde, Tex.*

[For explanations of symbols see note at top of Table 1]

Pen No.	Material administered[1]	Dose per hen	Hen No.	Weight at beginning of test	Loss (-) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		Head-louse infestation		[illegible]		[illegible]		[illegible]	
						Health	Appetite	Bowels	Beginning	End	Beginning	End	Beginning	End	Beginning	End	Number applied	Percentage engorged	[illegible]	[illegible]
		Grams		*Lbs. Oz.*	*Ounces*															
5	Potassium bi[illegible]	[illegible]	[illegible]	3 9	-1	OK	OK	SL	I	M	I	F	M	VH	[illegible]	[illegible]	425	32.7	500	60-75
	do	[illegible]	[illegible]	4 12	[illegible]	OK	OK	N	F	I	O	O	L	VH	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 [illegible]	[illegible]	OK	OK	L	M	F	F	O	M	H	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 13	[illegible]	OK	OK	SL	M	M	H	M	M	H	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 0	[illegible]	OK	OK	L	H	VH	F	F	F	M	[illegible]	[illegible]				
1	Potassium [illegible]	[illegible]	[illegible]	5 1	[illegible]	OK	OK	N	M	VH	F	O	L	M	[illegible]	[illegible]	[illegible]	39.8	500	60-[illegible]
	do	[illegible]	[illegible]	4 12	[illegible]	F	OK	N	M	M	F	F	F	M	[illegible]	[illegible]				
	do	[illegible]	[illegible]	5 0	[illegible]	OK	OK	SL	L	VH	O	O	L	M	[illegible]	[illegible]				
	do	[illegible]	[illegible]	5 [illegible]	[illegible]	OK	OK	N	L	VH	O	O	M	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 11	[illegible]	OK	OK	SL	M	H	O	O	F	M	[illegible]	[illegible]				
2	Sodium [illegible]	[illegible]	[illegible]	3 15	[illegible]	OK	OK	N	L	F	O	O	H	M	[illegible]	[illegible]	[illegible]	45.9	[illegible]	[illegible]
	do	[illegible]	[illegible]	4 2	[illegible]	OK	OK	N	I	H	O	O	L	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	6 [illegible]	[illegible]	OK	OK	N	H	H	O	O	L	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 12	0	OK	OK	N	H	H	F	F	F	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	4 6	[illegible]	OK	OK	N	F	F	O	O	F	I	[illegible]	[illegible]				
3	Potassium [illegible]	[illegible]	[illegible]	6 0	[illegible]	OK	OK	SL	H	H	F	F	F	I	[illegible]	[illegible]	[illegible]	43.3	500	60-[illegible]
	do	[illegible]	[illegible]	4 4	[illegible]	OK	OK	SL	VH	H	O	O	VH	VH	[illegible]	[illegible]				
	do	[illegible]	[illegible]	3 13	[illegible]	OK	OK	SL	F	M	F	F	F	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	3 14	[illegible]	OK	OK	N	F	F	O	O	I	I	[illegible]	[illegible]				
	do	[illegible]	[illegible]	3 [illegible]	[illegible]	OK	OK	L	F	M	F	F	M	M	[illegible]	[illegible]				
4	Sodium sulphate	.5	[illegible]	6 2	[illegible]	OK	OK	N	F	I	O	O	F	F	[illegible]	[illegible]	[illegible]	41.9	500	60-75
	do	.5	[illegible]	5 [illegible]	[illegible]	OK	OK	SL	H	H	F	F	I	F	[illegible]	[illegible]				
	do	.5	[illegible]	3 [illegible]	[illegible]	OK	OK	N	F	I	O	O	F	I	[illegible]	[illegible]				
	do	.5	[illegible]	4 [illegible]	[illegible]	OK	OK	SL	H	H	L	I	I	I	[illegible]	[illegible]				
	do	.5	[illegible]	4 [illegible]	[illegible]	OK	OK	N	F	I	O	O	I	I	[illegible]	[illegible]				
6	[illegible]	6.0	[illegible]	4 11	[illegible]	OK	OK	N	F	VH	O	O	F	I	[illegible]	[illegible]	[illegible]	48.9	500	60-75
	do	6.0	[illegible]	5 [illegible]	[illegible]	OK	OK	N	M	H	O	O	M	M	[illegible]	[illegible]				
	do	6.0	[illegible]	5 [illegible]	[illegible]	OK	OK	N	M	H	O	O	M	M	[illegible]	[illegible]				
	do	6.0	[illegible]	3 [illegible]	[illegible]	OK	OK	N	M	VH	M	O	M	M	[illegible]	[illegible]				
	do	6.0	[illegible]	4 [illegible]	[illegible]	OK	OK	N	H	H	F	O	M	I	[illegible]	[illegible]				
7	None (control)		[illegible]	3 [illegible]	[illegible]	OK	OK	N	F	H	F	F	I	I	[illegible]	[illegible]	425	60.8	[illegible]	60-75
	do		[illegible]	4 [illegible]	[illegible]	OK	OK	N	F	H	O	O	M	M	[illegible]	[illegible]				
	do		[illegible]	4 [illegible]	[illegible]	OK	OK	N	I	H	F	F	M	I	[illegible]	[illegible]				
	do		[illegible]	5 12	[illegible]	OK	OK	N	F	I	O	O	M	M	[illegible]	[illegible]				
	do		[illegible]	5 [illegible]	[illegible]	OK	OK	N	I	F	O	O	M	I	[illegible]	[illegible]				

[1] All doses were administered daily, except [illegible], and [illegible] the [illegible] were given in capsules.

TABLE 8.—*Results of pen tests to determine the effect on [illegible] of the [illegible] of certain materials to hens, April 7–2[illegible], 1925, [illegible], Tex.*

[For explanation of symbols see note at top of Table 1]

Pen No.	Material [illegible] used	[illegible]	Hen No.	Weight at beginning of test	Loss (−) or gain (+) at end of test	Condition of hen at end of test			Body-louse infestation		Shaft-louse infestation		[illegible]		[illegible]		Fowl [illegible]		Mites on [illegible]	
						[illegible]	[illegible]	[illegible]	Beginning	[illegible]	Beginning	End	Beginning	[illegible]	[illegible]	[illegible]	Number applied	[illegible]	Number applied [illegible]	[illegible]
		[illegible]		[illegible] Oz.	Ounces															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	1,[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	L	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				
1	Po[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	L	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				
3	Po[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	SL	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
[illegible]	None [illegible]		[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]	500	[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]		[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	O	[illegible]	[illegible]	[illegible]				
	[illegible]		[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				
	[illegible]		[illegible]	[illegible]	[illegible]	OK	OK	N	[illegible]	[illegible]	[illegible]	[illegible]	F	[illegible]	[illegible]	[illegible]				

[1] All hens were [illegible] and were given in [illegible]

TABLE 9.—[illegible] Tables 1 and 2, showing effects of internal medication of fowls on their ectoparasites

Pen No.	Material administered	Dosage [illegible]	Loss (−) or gain (+) [illegible]	[illegible]			[illegible]		[illegible]	
				[illegible] louse	[illegible] louse	[illegible] louse	[illegible]	[illegible]	[illegible] applied	[illegible]
		Grams	Ounces							
8	Potassium bitartrate	2.0	−6	+1	−3	+9	16	264	625	32.7
1	Potassium nitrate	.16	−11	+9	−1	+5	31	130	625	38.5
2	Sodium nitrate	.14	−17	+1	0	+1	35	625	625	45.9
3	Potassium sulphate	.56	−18	+3	0	+1	4	115	625	42.3
4	Sodium sulphate	.8	+9	+2	0	+1	19	625	625	41.9
6	Garlic	6.0	−7	+9	−4	+2	41	106	625	43.9
7	None (control)		−10	+8	0	+2	23	205	625	40.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	Potassium tellurite	.02	−20	−4	+2	0	725	2,400	500	[1] 65.2
5	Tartar emetic	.002	−12	−1	+5	0	900	2,120	500	54.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Potassium carbonate	1.0	−22	0	+8	+1	1,060	2,320	500	50.2
4	None (control)		+1	+3	+2	+3	1,300	2,130	500	32.4

[1] [illegible] Table 1.

[2] [illegible]

EFFECT OF INTERNAL MEDICATION ON POULTRY

WEIGHT

All hens were weighed at the beginning and at the end of each test, and those included in the results shown in Tables 1 and 2 were weighed one or more times during the tests. There was considerable variation in the losses and gains in weight, but as a whole there was a loss in weight as compared with the controls. Several of the treated hens made a loss in the dosage tests and a gain in the pen tests, and the reverse occurred in some cases.

HEALTH

At the beginning of the tests all of the hens appeared healthy. In the tables "OK" signifies that the hen was apparently not affected by the medication; "F" (fair) indicates that the hen was appreciably affected but was at no time down and unable to walk; "P" (poor) indicates that the hen at some time was down and was adversely affected by the medication. The health of the hens was unusually good in tests shown in Table 1, as small dosages were administered at that time. Appreciable deleterious effects were apparent in the tests of magnesium oxide, naphthalene, camphor, and capsicum. During the tests no improvement could be observed in health or vigor of the treated hens, nor was there any appreciable improvement in the health of these hens after the period of treatment.

APPETITE

The appetite of the hens was judged to some extent by the quantity of mash consumed, but more by their eagerness for grain after the capsules were administered. In the tables "OK" under the heading "Appetite" indicates that the hens were eager for grain; "F," that they would eat a little and stop; "P", that they would pay little attention to the feed.

The appetite of the hens was remarkably good in nearly all cases, even in the case of those showing loss of weight and poor health. The only cases of appreciably adverse effects on appetite were found in the tests of camphor gum, capsicum, magnesium oxide, and calcium polysulphide A. No increase in appetite was observed which could be attributed to the effects of medication.

BOWELS

The condition of the bowels was noted from time to time. "N" indicates that the droppings were firm (normal); slightly loose, designated "SL," indicates that the droppings were soft; and loose, designated "L," indicates that the droppings were watery and without form. Sulphur and magnesium sulphate appeared to be quite laxative in their effect, and all of the sulphur compounds were apparently more or less laxative in action. Potassium bitartrate, diethyl diselenide, and potassium iodide were also more or less laxative. No tendency to constipation was observed which could be attributed to the effects of medication.

EFFECT OF INTERNAL MEDICATION ON EXTERNAL PARASITES

In studying the tables showing the effect of the treatment of the hens on the parasites it is well to keep in mind that other factors might have had an effect on the degree of infestation. This is especially true when parasites were allowed to breed on hens or in the pens during the tests. Although precautions were taken to prevent effects of outside influences, such influences can not be entirely eliminated. Erroneous conclusions may be avoided if one studies the infestations on individual hens in a series as compared to the infestations of parasites in each pen. All of the pens retained the same numbers through the tests except pen No. 8, which became No. 6 in Tables 7 and 8. It must be realized that climatic conditions have different influences at different seasons. A pen might be located so that it would receive a maximum of sunshine during a period when the air temperatures were comparatively high for insect development. On the other hand, when air temperatures were comparatively low for insect development, the increased sunshine in a pen might be advantageous to the development of that insect. In the discussion of results attention is called to interfering factors as far as possible, but it must be remembered that there are some such factors that are not yet fully understood.

Observations were made at frequent intervals to determine if there were any apparent dislikes on the part of parasites to feeding on medicated hens, but none were observed. All of the parasites fed freely and normally, and apparently there was no repellent effect. All species which were tested reproduced and developed in a normal manner, and in no case was any deleterious effect observed in any generation.

POULTRY LICE

Unfortunately there is no way of determining with accuracy the number of lice on a fowl, but fairly consistent results are obtainable if an experienced observer estimates the number after having carefully examined all parts of each fowl. The louse infestations were arbitrarily designated as none or "O," very few, few, light, medium, heavy, and very heavy. The degree of infestation corresponding to each designation was fixed in mind, and in making the records no reference was made to previous notes. The infestations of each hen with each of the three species of lice considered was estimated at the beginning and end of each test, and in some cases at intervals during the test. The change in degree of infestation is referred to as change in "points", a point of gain being the change, for instance, from a light to a medium infestation. It is realized that there was a chance of irregularity in recording the results in that the recorded data are based on estimates and an unchanged infestation might be recorded as a change of one point. In computing the summaries this element of chance enters, though the percentage of error is not sufficient to alter the results from a practical viewpoint. In several cases distinct increases or decreases in the infestations were observed and recorded, but such cases occur under natural conditions and were observed as frequently in the controls as among treated hens. Furthermore, the decreases observed were not sufficient, in a series of fowls, to be considered of practical value. The reasons for these fluctuations are not always fully understood. Activities of individual hens vary in such ways as to affect the louse infestations. Since no deleterious effects were observed on the lice as a result of any of the medications, such variations as have been shown in the tables may be attributed to the estimation of degrees of infestation or to causes other than medication.

Although the louse infestations were not always as heavy as desired, the body, shaft, and head louse infestations in at least one test with each of the chemicals (excepting the head louse with the test of potassium tellurite) were sufficient to determine that there was no adequate control of any of the species from any of the chemicals administered in these tests.

In a test carried out by the late H. P. Wood in 1919, four fowls were infested with six species of lice. The fowls were fed with nux vomica, 1 part by weight being mixed with 30 parts of mash. During a seven-day test there was no noticeable effect on the lice, but one of the fowls was apparently adversely affected by the medication.

The body louse (*Menopon biseriatum*) feeds on the epidermal layers more than the shaft or head louse, and in heavy infestations a scurf is formed which serves as a protective covering for large numbers of lice. Such a habitat would suggest that this species might be affected by changes that occur in the body excretions of the epidermal layers and that it might be a good index in the study of repellent effects which might be produced by internal medication. There is a tendency for the body louse to leave the hens under certain conditions. This migration takes place most noticeably in heavy infestations. In one instance, several hundred lice were found on the clothing and bodies of investigators after they had examined a flock heavily infested with the body louse. In a study of the tables it will be observed that there were "losses" and "gains" in the body-louse infestations on individual hens receiving the same treatment. In no case was there a loss in infestation on all hens treated with any chemical.

BLOOD-SUCKING PARASITES

In computing the results of the medications on blood-sucking parasites it will be observed that they are more consistent in showing relative effects than in the case of the lice. No repellent or deleterious effects were observed on individual parasites of hens treated with any chemical.

Infestations by the tick, *Argas miniatus*, were determined in counts in the pen tests. The percentage of ticks recovered indicates in a positive manner that internal medications of fowls did not affect ticks. They drop normally from the fowls when they have become engorged with blood. In the tests five hens were kept in each pen and the ticks were placed on the roosts of the pens at the end of each week. It was impossible to find all of the engorged ticks, but the percentage given is that of the actual number of engorged ticks recovered from the roosts.

In the dosage tests the results could not be recorded accurately, as the number of larvae engorging on the hens could not be counted. The effect of the medication on the health of the hens was also indicated by the percentage of ticks recovered, as a hen in poor health and inactive would not pick the ticks from her body as would a healthy hen. The ticks are larger than the other parasites and attach in such places that hens can pick them easily. Climatic factors do not interfere with the engorgement of ticks as much as with the engorgement of mites and fleas.

In no case has any effect been observed from any chemical on the engorgement, molting, or oviposition of the ticks. The tick eggs hatched normally, and the larvae appeared normal in every way. The nymphs and adult ticks reared from such material always appeared normal and active.

Tables 10 and 11 give the ratios of engorged ticks from the pens of medicated hens to the engorged ticks from the control pens.

TABLE 10.—*Ratios of engorged ticks recovered from roosts of medicated pens to the engorged ticks (considered as 100 per cent in each series) recovered from the control pens (Tables 3, 4, and 5 combined)*

Material	Percentage	Chemical	Percentage
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TABLE 11.—*Ratios of engorged ticks recovered from roosts of medicated pens to the engorged ticks (considered as 100 per cent in each series) recovered from the control pens (Tables 7 and 8 combined)*

Material	Percentage	Chemical	Percentage
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

In most cases more ticks were recovered from the medicated pens than from the control pens. These results were due to the fact that, in the case of the hens receiving the medication, vitality was reduced and health impaired to such an extent that the fowls did not disturb or destroy the ticks by picking. This might be expected from any improper medication of a flock of hens. The reduction in numbers of ticks was so slight on any of the treated fowls that it is probably attributable to normal fluctuation rather than to the medication.

In other tests conducted in 1923 hens were fed tobacco dust mixed with mash, and nux vomica and quinine were administered in capsules. The tobacco dust, containing about 1 per cent nicotine, was mixed with commercial mash and kept before the hens during the test. The lighter dosages of tobacco dust, as indicated in Table 12, were given during the first part of the test. Quinine sulphate was administered every other day for a period of 22 days (11 doses). The nux vomica was given each day, 1.5 grains the first week, 2 grains the second week, and 3 grains the third week.

There were two hens in each test, and the results are given in Table 12. There was no effect on degree of engorgement, molts, oviposition, or hatching of eggs of the tick as a result of medication of the hosts with the substances shown in this table.

TABLE 12.—*Tests of effects on fowl ticks of feeding various substances to hosts, 1923*

Material	Dosage	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	Per cent
Quinine sulphate	[illegible]	[illegible]	[illegible]	[illegible]
Nux vomica	1.5 to 3 grains	[illegible]	[illegible]	[illegible]
Tobacco dust	[illegible]	[illegible]	[illegible]	[illegible]
Do.	[illegible]	[illegible]	[illegible]	[illegible]
Control	[illegible]	[illegible]	[illegible]	[illegible]

FLEAS

Infestations by the sticktight flea (*Echidnophaga gallinacea*) were determined by actual count of the number of fleas attached to the hens in the lighter infestations, and by count and estimation in the heavier infestations. The tests were run for a period longer than individual fleas have ever been observed to remain attached to hens at Uvalde, Tex. The infestations on hens at the end of the tests were always fleas that had bred in the pens during the tests. In most cases the duration of each of the series of tests was longer than periods necessary for the development of fleas from the egg stage. Since fleas breed in the soil on the floor of poultry pens, and fowls were confined to these pens, it is possible that the immature stages of the fleas were affected by the chemicals which passed through the bowels of the hens. The quantity of the materials passed by the hens was especially noticeable in the pen where fowls were treated with ferric oxide. This showed a deep red color over the entire floor. The position of the pens allowed some to be more or less affected by climatic conditions. Pen No. 6 was located at the south side of a building in tests shown in Tables 3, 4, and 5. There was also a tree that overspread this pen on the west side. As the weather was very hot and dry during these tests, the protection was advantageous for development of the immature stages of fleas in this pen.

The original flea infestations in the soil of the pens were not killed or disturbed when later tests were started. The infestations for the first series of pen tests (Table 3) were used through all series of later tests. Pens Nos. 1 to 6 were infested in the first series of pen tests (Table 3), 7 and 8 in the second series (Table 4), and 9, 10, and 11 in the third series (Table 5). Additional soil infested with immature stages was introduced into the pens at the beginning of each succeeding series of tests.

It must be remembered in studying the results of tests shown in Tables 3, 4, and 5 that there were unfavorable climatic conditions for flea development. The tests summarized in Table 6 were begun before the weather was warm enough for uninterrupted development, but were continued so that the latter part of each test was made during a very favorable period. The weather conditions during the experiment given in Table 8 were very favorable for flea development and activity.

The recorded data and observations indicate very conclusively that fleas bred in the pens, attached to the hens, fed normally, and reproduced in a normal manner, giving rise to other generations.

MITES

The chicken mites (*Dermanyssus gallinae*) were counted when put on the roosts, but only estimates could be made of the numbers at the end of the tests, as they were so active that many were lost. The climatic conditions and the roost construction were not favorable for the development of the mites, and it was difficult to maintain an infestation in any of the pens. In series 6 (Table 7) engorgement and oviposition of the mites took place in all of the pens, and the mite eggs which were collected hatched normally. The longevity of mites collected from the roosts of all pens was approximately the same as that for other mites kept under laboratory conditions. In series 7 (Table 8) the infestation was maintained during the last two weeks of the experiment, and it will be observed that the estimated infestations at the end of the tests bear some relation to the percentage of ticks engorged in the same pen.

SCALY-LEG MITES

One or more hens in each test were infested with scaly-leg mites (*Cnemidocoptes mutans*). Microscopic examination was made of scales from the legs of at least one hen receiving each chemical. There was apparently no effect on the mite and in no case did the trouble disappear, even though some of the hens were held for more than a month after the tests were completed.

CONCLUSIONS

The proprietary remedies which are designed for internal administration against external parasites consist of one or several of the materials tested in connection with this investigation.

The tests reported herewith show conclusively that the external parasites of the hen are not adequately controlled by internal treatment with the chemicals used.

In no case have any deleterious effects been observed on any of the parasites feeding upon the hens to which any of the materials were administered. In all cases the parasites fed upon the medicated hens normally, reproduced normally, and, as far as was determined, developed normally thereafter.

Where internal medication for external parasites has been used by poultry raisers and apparently beneficial results have been obtained, it is probable that those making such tests were misled by the lack of knowledge of the habits of the parasites or by extraneous factors not considered.

There is grave danger in giving certain internal medicaments to fowls, as their vitality may be decreased to such an extent that they may actually become more heavily infested with parasites as a result of the medication.

The use of internal medications against external parasites is detrimental to the poultry industry in that it not only involves useless expenditures but allows the parasites to continue their ravages when they might be destroyed by recognized methods.

Furthermore, it seems safe to conclude that any internal medication for the control of external parasites is without value for that purpose.

PART 2. TESTS WITH PROPRIETARY PREPARATIONS USED IN THE FOOD AND DRINKING WATER FOR THE CONTROL OF EXTERNAL PARASITES OF POULTRY

INTRODUCTION

During the last two or three years the entomologists of the Insecticide and Fungicide Board,[3] working in the Bureau of Entomology, have tested a considerable number of proprietary preparations that were recommended for use in the food and drinking water of poultry for the control of external parasites. This method of overcoming one of the poultryman's greatest problems appears so simple and has been so extravagantly advertised that these nostrums have found a ready market.

In almost every case it is claimed that the use of these remedies as directed will cause all parasites to leave the fowls and eradicate any "vermin" that may be in the poultry house. Sometimes it is claimed that they will also render the treated fowls immune to the attacks of all vermin. The exact way in which these astonishing results are supposed to be produced is not stated, but many ingenious theories are advanced, most of them based on the idea that the sulphur is changed to hydrogen sulphide, which in some way kills the pests or renders their surroundings so distasteful that they all leave the fowls and starve to death.

In all of the following tests fresh samples, purchased on the open market, were used, and the manufacturers' directions were very carefully followed. In some cases these experiments were duplicated, an increased dosage being used, or the material given for a longer time than recommended. The experiments were carried out under natural conditions, each set of fowls having a separate pen and yard. Unless otherwise noted, the houses were infested with the common chicken mite (*Dermanyssus gallinae* De Geer). The louse infestation varied somewhat in the different tests, but the common body louse (*Menopon biseriatum* Piaget) and the shaft louse (*Menopon pallidum* Nitzsch) were always found in considerable numbers. The wing louse (*Lipeurus variabilis* Nitzsch) was generally present, and the large hen louse (*Goniocotes abdominalis* Piaget) was occasionally found.

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[3] See footnote 5.

The houses were examined at the time the treatment was started, and at irregular intervals until the close of the experiment, to determine the infestation of mites. The fowls were examined carefully before the test was started, several times during treatment, and at the close of the experiment to determine the effect of the preparation on lice. Since these experiments were designed primarily to show the practical value of these remedies, no attempt was made to record minor fluctuations in the number of insects present from day to day, but the value of the material was determined by the condition of the flock and the house after the preparation had been given for the stipulated period.

All of the preparations tested were analyzed by the Insecticide and Fungicide Board, and their essential components are given in the following tables.

The preparations here discussed may be divided into three general classes, as follows: (1) Liquid lime-sulphur to be given in the drinking water or used in preparing a wet mash; (2) tablets, largely calcium sulphide, calcium thiosulphate, and calcium sulphate, to be dissolved in the drinking water or given in a mash; and (3) powders to be mixed with the feed.

EXPERIMENTS WITH LIQUID LIME-SULPHURS

Table 13 gives the results of tests with liquid lime-sulphur used in the drinking water. In these tests no other water was accessible. In experiments 6, 16, 17, 18, and 19 the materials were also given in a wet mash for 6, 7, 16, 14, and 10 days, respectively.[6]

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[6] Experiments 11, 12, 21, and 26 were carried on by O. G. Babcock, 5 and 28 by D. C. Parman, and 29 by F. C. Bishopp, all of the Bureau of Entomology.

Table 13.—*Composition of and results of tests with liquid lime-sulphur given in drinking water for the control of external parasites of poultry*

Test No.	Composition					Dilution	Time of treatment	Effect on—		
	Calcium polysulphides	Calcium thiosulphate	Calcium sulphate	Total sulphur	Water			Lice	Mites	Other parasites
	Per cent	*Per cent*	*Per ct.*	*Per ct.*	*Per ct.*		*Days*			
1	7.05	1.52	0.13	-------	91.30	1 to 263	7	Ineffective	No tests	
2	28.54	2.61	.25	23.80	68.60	1 to 4,204	16	do	Ineffective	
3	28.54	2.61	.25	23.80	68.60	1 to 4,204	6	do	do	
4	28.54	2.61	.25	23.80	68.60	1 to 4,204	17	do	do	
5	28.54	2.61	.25	23.80	68.60	1 to 4,204	12	do	No tests	Ineffective, ticks and fleas.
6	27.54	3.56	(1)	23.30	68.9	1 to 4,204	14	do	Ineffective	
7	5.65	1.88	.17	5.16	[2] 91.16	1 to 2,102	12	do	do	
8	5.05	2.17	(1)	5.30	92.53	1 to 2,102	10	do	do	
9	5.65	1.92	(1)	5.36	92.42	1 to 2,102	10	do	do	
10	5.65	1.92	(1)	5.36	92.42	1 to 2,102	12	do	do	
11	7.10	1.02	.04	5.83	91.84	1 to 2,102	27	do	do	Ineffective, ticks, and scaly leg.
12	7.10	1.02	.04	5.83	91.84	1 to 2,102	5	do	No tests	Ineffective, ticks.
13	7.10	1.02	.04	5.83	91.84	1 to 2,102	20	do	Ineffective	
14	3.94	2.47	(1)	4.09	93.50	1 to 2,102	17	do	do	
15	5.50	2.37	0	5.49	[3] 90.7	1 to 2,102	11	do	do	
16	6.68	3.23	.17	6.46	89.92	1 to 2,166	21	do	do	
17	7.80	3.99	.17	7.39	88.04	1 to 2,166	16	do	No tests	
18	7.80	3.99	.17	7.39	88.04	1 to 2,166	15	do	do	
19	7.80	3.99	.17	7.39	88.04	1 to 2,166	13	No tests	Ineffective	
20	29.88	3.25	0	25.08	66.87	1 to 4,200	11	Ineffective	do	
21	28.20	2.61	.08	23.40	69.11	1 to 4,288	15	do	No tests	Ineffective, ticks.
22	31.01	2.06	.08	25.29	66.85	1 to 4,288	10	do	Ineffective	
23	31.01	2.06	.08	25.29	66.85	1 to 4,288	10	do	do	
24	29.09	2.63	.17	24.17	68.11	1 to 4,288	10	do	do	
25	28.81	2.33	.13	23.80	68.73	1 to 4,288	10	do	do	
26	28.81	2.33	.13	23.80	68.73	1 to 4,288	26	do	No tests	Ineffective, ticks.
27	30.90	2.14	0	25.25	66.96	1 to 4,288	21	do	Ineffective	
28	30.34	-------	-------	25.17	-------	1 to 4,600	5	do	No tests	Ineffective, ticks, and fleas.
29	28.20	2.61	.08	23.40	69.11	1 to 4,288	53	do	Ineffective	Ineffective, ticks.

[1] Trace.

[2] Also contains alcohol 0.14 per cent.

[3] Also contains 1.43 per cent of sugars and sulphur.

The experiments given in Table 13 show that none of the preparations tested was of any value against the insects used. The materials were given at several different dilutions, and for periods of time ranging from 5 to 53 days without producing any noticeable effect on the parasites. The results include 28 tests against lice, 21 tests against mites, 7 tests against fowl ticks, 2 tests against sticktight fleas, and one against scaly-leg mites, and would seem to warrant the conclusion that this method of treatment is of no practical value against the common external parasites of poultry.

EXPERIMENTS WITH TABLETS CONTAINING SULPHUR COMPOUNDS

Table 14 gives the results of 14 tests with tablets containing sulphur compounds used in the drinking water. In these experiments no other water was given to the fowls.[7]

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[7] Experiment 8 was carried on by F. C. Bishopp.

Table 14.—*Composition of material and results of tests with tablets containing sulphur compounds, given in the drinking water for the control of external parasites of poultry*

Test No.	Composition						Weight of each tablet	Tablets per gallon of water	Time of treatment	Effect on—	
	Calcium sulphide	Calcium thiosulphate	Calcium sulphate	Calcium oxide	Siliceous material	Other substances (by difference)[1]				Lice	Mites
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Grams*		*Days*		
1	51.39	0.78	12.57	7.40	([2])	27.86	0.22	2 1	7 7	Ineffective.	Ineffective.
2	37.75	3.51	5.77	14.50	3.23	35.34	.22	2	13	do	No tests.
3	42.39	.95	6.37	14.31	3.25	32.73	.22	2	7	do	Do.
4	42.97	1.14	6.66	12.43	3.68	33.12	.22	2	16	do	Ineffective.
5	38.74	3.13	26.79	6.67	6.88	[3] 17.79	.22	2	19	do	Do.
6	38.74	3.13	26.79	6.67	6.88	17.79	.22	2	15	do	Do.
7	32.13	8.35	10.02	9.60	3.25	36.65	.23	2	7	do	Do.
8	28.03	2.59	16.05	5.79	5.90	41.64	.285	2	19	do.[5]	No tests.
9	28.03	2.59	16.05	5.79	5.90	41.64	.285	2 1	7 7	do	Ineffective.
10	23.78	1.47	7.05	8.77	7.43	[4] 51.50	.3	2 1	14 7	do	Do.
11	42.42	3.27	1.80	([2])	([2])	52.51	.25	4	15	do	Do.
12	42.42	3.27	1.80	([2])	([2])	52.51	.25	4	15	do	Do.
13	42.42	3.27	1.80	([2])	([2])	52.51	.25	4	15	do	Do.
14	42.42	3.27	1.80	([2])	([2])	52.51	.25	12	8	do	Do.

[1] Includes moisture, free sulphur, carbon dioxide, oxides of iron and aluminum, starches, and sugars.
[2] Trace.
[3] Includes calcium polysulphides, magnesium oxide, and alkalies.
[4] Includes sodium sulphate, 2.98 per cent.
[5] Also ineffective against ticks.

Table 14 includes the results of 14 tests against lice and 11 tests against mites. These results, with one test against ticks, show that, under the conditions here described, these preparations were of no value against the common poultry parasites.

EXPERIMENTS WITH POWDERS GIVEN IN THE FOOD

Three samples of this type have been tested. For convenience they have been designated A, B, and C and are considered in detail below.

PREPARATION A

Three different samples of the material designated preparation A were tested. Although their analyses showed slight variations, the general composition was as follows:

	Per cent
Sulphur, S	34.53
Sodium and potassium carbonates	11.94
Sodium chloride, NaCl	8.13
Sodium sulphate, Na_2So_4	2.45
Calcium carbonate, $CaCO_3$	8.05
Calcium hydrate, $Ca(OH)_2$	5.27
Magnesium oxide, MgO	5.09
Iron and aluminum oxides, R_2O_3	10.81
HCl-insoluble ash (sand and silica)	7.95
Moisture, organic matter (charcoal), and undetermined substances	5.78
Total	100,00

This material was mixed at the rate of 1 heaping tablespoonful to a quart of moistened food and given to the poultry three times a week for from four to six weeks. Six tests were made, from 5 to 10 fowls being used in each experiment. Five of these flocks were infested with lice and mites, and the sixth [8] with lice and ticks.

At the close of these experiments a careful examination of the fowls gave no indications that the treatment had had any effect on these parasites.

PREPARATION B

Preparation B contained from 64 to 74 per cent of sulphur, from 11 to 15 per cent of ferrous sulphate, and from 15 to 17 per cent of charcoal.

In three experiments [9] samples of this material were given at the rate of 1 tablespoonful in moist mash for every 12 hens for 15 days. In the first experiment 2 hens were infested with chicken lice and fowl ticks; in the second, 8 hens were infested with fowl ticks; and in the third, 34 hens were infested with sticktight fleas, fowl ticks, and chicken lice. In two other tests this material was given at the same dosage for 8 and 10 days, to flocks of 12 hens infested with lice and mites and in a third test at twice this dosage for 8 days.

In none of these experiments was there any indication that the treatments given had any effect on the parasites that were present.

PREPARATION C

Preparation C contained 11.7 per cent of sulphur, 45.5 per cent of magnesium sulphate (Epson salts), and nux vomica, mustard, and red pepper. This sample was fed at the rate of 1 tablespoonful to 2 quarts of grain three times a day for four weeks, to a flock of 27 fowls, and was found to have no effect on chicken lice.

CONCLUSIONS

Not one of the preparations here considered, when given in the food or drinking water, showed any indications of value against the parasites used in these experiments.

These tests, considered with the feeding experiments reported in Part 1 of this bulletin, show conclusively that preparations of this type, given in the food or drinking water, can not be of any practical value for the control of the common external parasites of poultry.

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[8] Experiment by F. C. Bishopp, Bureau of Entomology.

[9] Tests made by D. C. Parman, Bureau of Entomology.

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